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Gastrointestinal Parasites of the Blue Catfish (*Ictalurus furcatus*) in Kentucky Lake, Tennessee

TIMOTHY L. HOFFNAGLE,[1] R. A. COLE,[2] AND WESLEY L. SHOOP[3]
Hancock Biological Station, Murray State University, Murray, Kentucky 42071

ABSTRACT: Gastrointestinal tracts were collected from 56 blue catfish (*Ictalurus furcatus*) caught on commercial baitlines in Kentucky Lake, Tennessee. Fish ages ranged from 2 to 13 yr, lengths from 280 to 931 mm, and weights from 190 to 10,800 g. Eight species comprised the helminth community and included the following: 3 trematodes, *Allacanthochasmus varius, Crepidostomum cooperi,* and *Megalogonia ictaluri,* in 3.6% (2), 28.6% (16), and 89.3% (50) of the catfish, respectively; 3 cestodes, *Corallobothrium fimbriatum, Corallobothrium giganteum,* and *Proteocephalus fragile,* in 57.1% (32), 14.3% (8), and 7.1% (4) of the catfish, respectively; and 2 nematodes, *Dichelyne robusta* and *Spinitectus gracilis,* in 46.4% (26) and 92.8% (52) of the catfish, respectively. Certain helminth species showed increasing prevalence with greater age and/or size of the host (*A. varius, C. giganteum,* and *P. fragile*) and others showed the converse (*C. cooperi* and *M. ictaluri*). Each of these 2 opposing trends appeared to be correlated with food items of the catfish, i.e., infective stages of helminths prevalent in the younger/smaller catfish have been reported from mayflies, whereas infective stages of species prevalent in the older/larger catfish have been reported from small fish. Thus, as the catfish changes feeding habits from predominantly invertebrates to one including fish, it also changes the composition of its helminth community.

KEY WORDS: blue catfish, helminths, *Ictalurus furcatus,* survey, Tennessee.

Although numerous studies of the parasites of various catfish species have been conducted, virtually nothing is known about the helminths of the blue catfish, *Ictalurus furcatus.* The blue catfish is easily capable of living in excess of a decade, reaching over a meter in length, and weighing in excess of 50 kg. We had the opportunity to examine the helminths from the gastrointestinal tract of blue catfish from Kentucky Lake, Tennessee. Herein, we report 8 species previously unknown from this host.

Methods

All blue catfish were caught on commercial baitlines in Kentucky Lake, Tennessee, during July and August 1986. A maximum of 10 fish was sampled in sequential 100-mm length classes in an effort to obtain as wide a sampling of various age and size classes as possible. Because of the commercial baitlines, only length classes 200 mm and above were available for sampling, and because of the rarity of very old specimens, only length classes up to and including the 600-mm class reached their maximum. Blue catfish in the 600-mm length class were estimated to be in the 9-yr age class based on age–length relationships established for that species in that area of Kentucky Lake by Timmons et al. (1986). Although no length classes above 600 mm reached their maximum, blue catfish up to 931 mm were included in this study.

All catfish were measured, weighed, and their left pectoral spine removed. The latter was done for precise age determination upon return to the laboratory. Precise ageing was accomplished by counting annual rings on cross sections of pectoral spines. Also, the gastrointestinal tracts were removed, placed in separate plastic bags, and refrigerated at 4°C until necropsy. Necropsy procedures were standard and helminths were prepared using routine histological techniques. Voucher specimens have been deposited in the USNM Helminthological Collection.

Results

Fifty-six gastrointestinal tracts were collected from blue catfish ranging in age from 2 to 13 yr, in length from 280 to 931 mm, and in weight from 190 to 10,800 g. Eight species of helminths, apparently none of which has been reported previously from blue catfish, were found in their gastrointestinal tracts (Table 1). Each fish harbored a mean of 3.4 (range 0–6) helminth species with a distribution as follows: 1 fish had none, 1 had 1 species of helminth, 11 had 2, 13 had 3, 24 had 4, 5 had 5, 1 had 6, and no fish harbored either 7 or all 8 species.

As was expected, age, length, and weight of the hosts were highly correlated (Table 2), and thus, in Table 3 only the age of the hosts relative to the individual parasite species is given to illus-

[1] Present address: Department of Biology, University of North Dakota, Grand Forks, North Dakota 58202.

[2] Present address: Department of Pathobiology, School of Veterinary Medicine, Auburn University, Auburn, Alabama 36849.

[3] Present address: Merck, Sharp & Dohme Research Laboratories, P.O. Box 2000, Rahway, New Jersey 07065-0900.

Table 1. Prevalence and site of infection of gastrointestinal tract parasites of blue catfish from Kentucky Lake, Tennessee.

Species	Site*	No. infected	Prevalence (%)
Trematoda			
Allacanthochasmus varius (USNM #80737)	SI	2	3.6
Crepidostomum cooperi (USNM #80738)	SI	16	28.6
Megalogonia ictaluri (USNM #80739)	SI	50	89.3
Cestoda			
Corallobothrium fimbriatum (USNM #80740)	SI	32	57.1
C. giganteum (USNM #80741)	SI	8	14.3
Proteocephalus fragile (USNM #80742)	SI	4	7.1
Nematoda			
Dichelyne robusta (USNM #80743)	SI	26	46.4
Spinitectus gracilis (USNM #80744)	SI, S	52	92.8

* SI = small intestine; S = stomach.

trate our sample. The number of helminth species the blue catfish harbored increased with greater age until the 9-yr class, whereafter the numbers decreased. There were individual helminth species that varied with age of the host as well as others that did not. Among those that did were 2 groups: those that showed an increase in prevalence over age and size (*Allacanthochasmus varius, Corallobothrium giganteum, Proteocephalus fragile*) and those that showed a decrease (*Crepidostomum cooperi, Megalogonia ictaluri*). It should be noted that even though certain species decreased in prevalence over age classes they were still present in low numbers throughout. In contrast, those species that increased in prevalence were completely absent in the early age classes. Thus, when the mean numbers of species per host were plotted against the various age classes, the resulting curve resembled a sine wave (Fig. 1).

Discussion

The blue catfish is a known opportunistic omnivore feeding on whatever is available from an early age (Brown and Dendy, 1961). In Kentucky Lake, the 2 main food sources for blue catfish are mayflies and fish (Cannamela et al., 1978; Davis, 1979). Not surprisingly, most of the gastrointestinal parasites identified in this study can be classified by their intermediate hosts into those 2 major groups. For example, metacercariae of *M. ictaluri* encyst in the gills of mayfly nymphs that are ingested by catfish (Hopkins, 1934). Metacercariae of *C. cooperi* encyst in the gills of mayfly nymphs and may establish as adults in a variety of fish species (Hopkins, 1934). The infective stages of *Spinitectus gracilis* can also occur in mayflies (Hoffman, 1967).

On the other hand, the metacercariae of *A. varius* encyst in minnow and other fishes (Hoffman, 1967). The life cycle of *P. fragile* is unknown but may be similar to that of other members of its genus in that small fish harbor the infective plerocercoid stage. *Corallobothrium fimbriatum* also has a plerocercoid that has been found in small fish (Allison, 1957), and presumably such is the case with *C. giganteum*. Unfortunately, *Dichelyne robusta* is the only species that cannot be categorized because, at least to our knowledge, nothing is known of its life cycle nor for any other member of its genus.

It may be inferred from the discussion above and Figure 1 that the high level of infection observed in the 2-yr age class of catfish was predominantly the result of ingestion of infective stages in mayflies. The 3 helminth species, 2 trematode and 1 nematode, that occur in mayflies can be thought of as "guild" (sensu Holmes, 1987) or, in other words, an association of parasites within a community that utilizes a similar

Table 2. Correlation coefficients for age, length, and weight of blue catfish collected in Kentucky Lake, Tennessee.

	Pearson correlation coefficients ($P > /R/$ under HO:RHO = 0)			Spearman correlation coefficients ($P > /R/$ under HO:RHO = 0)		
	Length	Weight	Age	Length	Weight	Age
Length	1.00000	0.87943	0.97816	1.00000	0.98486	0.98493
Weight	—	1.00000	0.89452	—	1.00000	0.97577
Age	—	—	1.00000	—	—	1.00000

Table 3. Prevalence and number of helminth species in age classes of blue catfish from Kentucky Lake, Tennessee.

Age (yr)	No. fish	Prevalence (%)* AV	CC	MI	CF	CG	PF	DR	SG	No. helminth species
2	9	0	78	100	89	0	0	44	100	5
3	5	0	20	100	80	0	0	40	100	5
4	6	0	17	100	33	0	0	17	83	5
5	8	0	25	100	50	0	0	38	88	5
6	9	0	22	89	56	44	0	33	89	6
7	5	20	20	100	100	20	0	80	80	7
8	3	0	33	100	33	33	0	67	100	6
9	5	20	20	80	60	40	20	80	100	8
10+	6	0	0	33	0	0	50	50	100	4

* Abbreviations are: AV, *Allacanthochasmus varius*; CC, *Crepidostomum cooperi*; MI, *Megalogonia ictaluri*; CF, *Corallobothrium fimbriatum*; CG, *C. giganteum*; PF, *Proteocephalus fragile*; DR, *Dichelyne robusta*; SG, *Spinitectus gracilis*.

resource (e.g., mayflies) in a similar manner. The subsequent decrease in parasitism observed in 3- and 4-yr-old catfish resulted from the decline of the mayfly guild and likely reflects the migration of catfish from shallow to deeper water that occurs at about 2 yr of age. For instance, with respect to the 2 trematodes that comprise the mayfly guild, *C. cooperi* and *M. ictaluri*, the shallow water is where the molluscs, mayflies, trematodes, and catfish overlap. As long as the catfish remain in the shallow water, the mayfly guild dominates. In deeper water, there is a decrease in number of both molluscs (first intermediate host) and mayflies (second intermediate host). Thus, in the deeper water 2 major factors for transmission are diminished. As a result, the total overall number of helminth species to which these age groups of catfish are exposed does not change, but the prevalence does.

After the fourth year of life it appears that the catfish diet begins to include a greater proportion of fish as evidenced by the acquisition of helminths comprising the fish "guild"; e.g., *A. varius, P. fragile,* and *C. giganteum* are known or suspected to utilize fish as second intermediate hosts. As a consequence of the overlap between the mayfly and fish guilds, both the total and mean number of helminth species per host increased until the ninth year class.

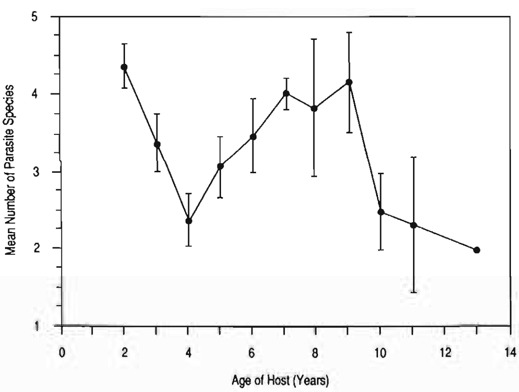

Figure 1. The mean number of helminth species per blue catfish plotted against the age of the host (in years).

The decreased parasitism in the very old catfish (>9 yr of age) is less readily explicable. Interestingly, Dogiel (1961, and references contained therein) noted this phenomenon, but could offer no explanation. In the present study, it may have resulted from 3 possibilities. First, it may be an artifact due to sampling error, because fish greater than 9 yr of age are so rare we were able to examine only 6. Second, it may be real and have resulted from the natural dearth of very old catfish coupled with a continuation of the ontogenetic change in feeding habit in which progressively larger fish prey (up to 400 mm in length) comprise the bulk of the diet. Conceivably, the small numbers of very old catfish and the parasite progeny generated therefrom may be below the threshold levels needed to propagate infection in a new group of larger prey. Third, rather than an ontogenetic explanation, it could be that these rare old catfish are sole survivors because they represented a subpopulation that was genetically less susceptible from the beginning of life. Thus, our results may be due to natural sampling error.

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Literature Cited

Allison, R. 1957. A preliminary note on the use of di-n-butyl tin oxide to remove tapeworms from fish. Progressive Fish Culturist 19:128–130.

Brown, B. E., and J. S. Dendy. 1961. Observations on the food habits of the flathead and blue catfish in Alabama. Proceedings of the Annual Conference of the Southeastern Association of Game and Fish Commissioners 15:219–222.

Cannamela, D. A., J. D. Brader, and D. W. Johnson. 1978. Feeding habits of catfishes in Barkley and Kentucky lakes. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 32:686–691.

Davis, W. L. 1979. A comparative food habit analysis of channel and blue catfishes in Kentucky and Barkley lakes, Kentucky. Master's Thesis, Murray State University, Murray, Kentucky.

Dogiel, V. A. 1961. Ecology of the parasites of freshwater fishes. Pages 1–47 *in* V. A. Dogiel, G. K. Petrushevski, and Y. I. Polyanski, eds. Parasitology of Fishes. Oliver and Boyd, Edinburgh. 384 pp.

Hoffman, G. L. 1967. Parasites of North American Freshwater Fishes. University of California Press, Berkeley. 486 pp.

Holmes, J. C. 1987. The structure of helminth communities. International Journal for Parasitology 17:203–208.

Hopkins, S. H. 1934. The papillose Allocreadiidae. A study of their morphology, life histories, and relationships. Illinois Biological Monographs 13: 1–80.

Timmons, T. J., R. S. Hale, T. L. Hoffnagle, and J. B. Soldo. 1986. Age, growth and catch analysis of commercial fishes in Kentucky Lake, Kentucky–Tennessee. Kentucky Department of Fish and Wildlife Resources, Project No. 2-418-R, Final Report, Frankfort, Kentucky.

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It is becoming more evident that the problem of animal product-borne diseases, such as toxoplasmosis, cysticercosis, trichinosis, capillariasis, angiostrongyliasis, gnathostomiasis, sarcosporidiosis, and trematodiases, is increasing. The economic consequences of these zoonoses for agriculture, and their associated public health impact, are quite severe in some regions of Southeast Asia and elsewhere in the world.

The development of animal production systems is handicapped by these problems, and a better understanding of the problems is needed before effective control strategies can be developed. Therefore, there is a need to bring capable scientists with the relevant experience from various parts of the world into contact with Southeast Asian agricultural and public health scientists to provide guidance on how to deal with the problems. We welcome participation by all interested individuals and groups.

For further information, contact Professor Chamlong Harinasuta, SEAMEO TROPMED Project, 420/6 Rajvithi Road, Bangkok 10400, Thailand; or Dr. John H. Cross, Department of Preventive Medicine and Biometrics, Uniformed Services University of the Health Sciences, 4301 Jones Bridge Road, Bethesda, Maryland 20814, telephone (202) 295-3139.